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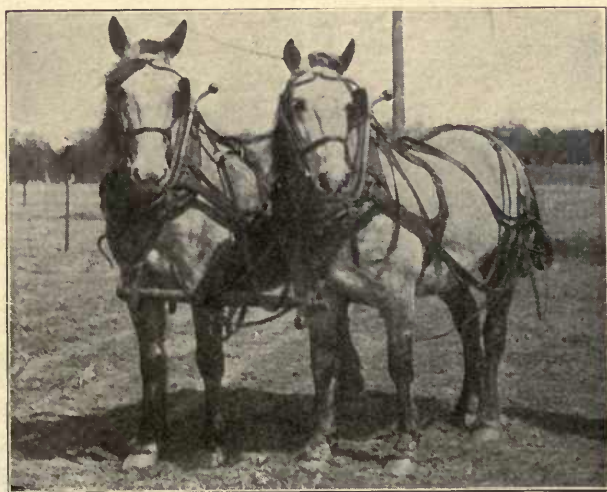
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UNIVERSITY OF ILLINOIS
Agricultural Experiment Station

BULLETIN NO. 150

FEEDING FARM WORK HORSES

By RUFUS C. OBRECHT



URBANA, ILLINOIS, AUGUST, 1911

SUMMARY OF BULLETIN No. 150

OBJECT.—A comparison of clover and timothy hay for farm horses at work; effect of mixing ground grain with chaffed clover hay; comparison of alfalfa hay with clover and with timothy hay, respectively; comparison of corn and alfalfa hay with a mixture of corn, oats, bran, oil meal, timothy and alfalfa hay; effect of grinding corn and oats when fed with wheat bran, timothy and alfalfa hay.

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PLAN.—Ten teams of horses were used in the various tests. They were well-bred grade geldings, except one team of mares, with a predominance of Percheron blood. The initial weight per horse was from 1003 to 1560 pounds; but the horses in the experiment proper only varied from 1250 to 1420 pounds. In general the plan was to feed the two horses of each team, simultaneously, on the respective rations to be compared and then reverse the rations for an equal length of time to eliminate the influence of individual feeding capacity of the horses.

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CLOVER AND TIMOTHY HAY COMPARED.—But little difference was observed in the value of clover and timothy hay when fed in conjunction with corn, oats, oil meal and wheat bran, the difference being slightly in favor of clover.

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MIXING GRAIN WITH CHAFFED CLOVER.—The results show a slight saving due to mixing ground grain with chaffed clover hay, but not sufficient to justify the expense.

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CLOVER AND ALFALFA HAY COMPARED.—Horses fed alfalfa and timothy ate less grain and hay and gained slightly more in weight than those fed clover and timothy while doing the same amount of labor.

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ALFALFA AND TIMOTHY HAY COMPARED.—20 to 22 percent less grain was required to maintain the weight of horses fed alfalfa than those fed timothy hay.

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CORN AND ALFALFA HAY COMPARED WITH CORN, OATS, WHEAT BRAN, OIL MEAL, TIMOTHY AND ALFALFA HAY.—Horses fed corn and alfalfa ate 22 percent less grain than those fed the mixed ration, and lost 6 pounds more in weight per head in eight weeks. The ration of corn and alfalfa cost 6 cents less per horse per day than the mixed ration.

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GRINDING CORN AND OATS.—Horses fed ground corn and oats with wheat bran, oil meal, timothy and alfalfa hay consumed 9 percent less feed and gained 3 pounds more in weight per head in six weeks than those fed whole corn and oats with a similar ration.

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CONCLUSIONS.

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FEEDING FARM WORK HORSES

By R. C. OBRECHT

ASSISTANT CHIEF IN HORSE HUSBANDRY

The problem of feeding work horses is one involving the economical production of energy, and maintenance of health. It is of considerable importance to know how much hay and how much grain a farm work horse at hard labor should receive in order that he may work with the greatest efficiency and economy. With high priced grains, it is very desirable to know the relative value of different roughages in order that economy may be practiced in making up a ration for work horses. In order to determine some of these points a number of experiments have been conducted at this Station in feeding College and Experiment Station horses used for teaming and field work.

OBJECT OF THESE EXPERIMENTS

The object of these experiments was to secure data for a comparison of rations for feeding farm work horses with respect to the following points: (1) maintenance of weight, (2) their health, spirit and ability to endure hard work, (3) economy of the ration.

In Bulletin 141, issued by this Station, it was shown that clover hay is greatly superior to timothy hay as the roughage part of a ration when fed in conjunction with corn and oats for fleshing horses for market. The question has been frequently asked regarding the relative merits of clover for feeding farm work horses. In order to throw some light upon this subject a test was made in which clover was compared with timothy hay.

PLAN

In the spring of 1908 a test was planned involving seven teams, whereby one horse in each team was to receive timothy hay, and the other clover hay. With but few exceptions each horse in the team worked an equal number of hours with his mate and at the same kind of labor. After three months one team became unfit for hard work, due to unsoundness of side-bones and spavins, and had to be discarded from the final results, thus leaving only six teams in the test. (Later three additional teams were used.)

The roughages used were choice timothy hay and choice clover hay. However, the timothy was of slightly better quality than the clover used, which was the best obtainable under local conditions. The clover hay (medium red variety) was of good quality and free from dust, but a little dark and contained some corn stalks. Each feed of hay was weighed to the horse and recorded and any refuse left was weighed back and deducted from the amount fed, which occurred more often with the horses receiving clover than those receiving timothy. The quantity of grain fed was left largely to the feeder's judgment, the amount being determined by the individuality of the horse, some receiving more than others. The grains fed were corn, oats, oil meal and bran. The corn was of good quality; the bran was of good grade, some from Minneapolis, and some from Kansas mills; the oil meal was old process pea size.

The test was divided into periods of four weeks each and extended over twelve periods, or 336 days. During the first seven periods one of the horses in each team was fed timothy and the other clover, while during the five remaining periods, the hay was reversed so that the horses first receiving timothy received clover and those receiving clover received timothy, thus checking any differences in the individuality of the horses.

All weights of the horses in this experiment both at the beginning and close of each period, were obtained by taking the average of three days' weights. The horses were weighed in the morning after receiving grain and hay but before watering, on the day previous to the close of the period or of the experiment as the case may be, the closing day and again the following day. During the hot weather a few of the teams received about two gallons of water in the morning before feeding and weighing, the quantity always being limited and the same amount given to each horse in the team. There is bound to be considerable fluctuation in the weight of horses from day to day owing to the amount of water consumed, the work done, and the amount of perspiration. Extreme cases show as much variation as seventy pounds on succeeding days under similar conditions of weighing.

One of the horses, No. 59, refused to eat oil meal and consequently it was omitted from his ration. This horse, apparently, was not in the best of health for he did not consume as much grain as he should have in order to maintain his weight. He appeared well but for some reason lacked appetite enough to consume relatively as much grain as the other horses. Each horse was branded with a number on his hoof as an identification mark and the records of the horses were taken by numbers rather than by names. The horses varied in age from four to nine years. With the exception of the one team above mentioned, all were sound and in good health and remained so thruout the experiment.

In recording the amount of work done it was graded as hard and medium labor. Hard labor involves such work as plowing, harrowing, working on the binder and mower and heavy teaming, such as hauling feed and manure. Medium labor involved such work as hauling manure over good roads, shelling corn, light cultivation, etc., some of which might be called hard labor by many teamsters. This division of labor is of course an arbitrary one for it is very difficult to say just where one stops and the other begins. In fact it is the total number of hours of labor that is of greatest importance. The work frequently required of the teams was such as would be done by three horses on most farms; for instance, plowing and working on a disc harrow or disc drill. However, the working hours were not so long. Ordinarily the teams were started to work at seven o'clock in the morning and worked until six at night with one hour for noon, with the exception of Saturdays when work usually stopped at five. During the winter months the work day was only nine hours.

THE HORSES

The horses were all well-bred grade geldings with the exception of one team, Nos. 51 and 52, which were mares. Most of them showed evidence of Percheron blood, tho some had more of the characteristics of the Shire and others of the Belgian. In selecting the horses an effort was made to get them as nearly uniform as possible in the team and with equal feeding qualities. They were all in good condition at the beginning of the experiment.

Two of the teams, Nos. 5 and 6, belonged to the Agronomy Department. These did the hardest work and most of it came during the spring and summer months, as most farm work does. Team No. 4 was owned by the Department of Dairy Husbandry. This team as well as the three teams owned and used by the Animal Husbandry Department, Nos. 1, 2 and 3, worked quite hard almost every work-day thruout the year. It frequently happened that the hauling of feed and manure over bad roads during the winter months was quite as hard as the farm work during the summer, with the exception of slightly shorter days.

In determining the cost of feeding the horses, the following prices for feeds were used:

Corn	50c per bushel
Oats	40c per bushel
Wheat bran	\$20.00 per ton
Oil meal	\$32.00 per ton
Clover hay	\$10.00 per ton
Timothy hay	\$12.00 per ton
Alfalfa hay	\$16.00 per ton

TABLE 1.—TEAM NUMBER, HOOF NUMBER, LOT NUMBER, BREED, AGE, AND INITIAL WEIGHT OF HORSES USED IN THESE TESTS

Team	Hoof No.	Lot No.	Predominance of breed character	April 2, 1908	
				Age	Weight
1	51	1	Percheron	8	1379
	52	2	Percheron	7	1378
2	57	1	Shire	4	1395
	58	2	Percheron	4	1375
3	60	1	} Shire	4	1292
			} Percheron		
	59	2	} Percheron	4	1292
			} Shire		
4	64	1	Belgian	6	1338
	65	2	Belgian	7	1420
5	66	1	Percheron	7	1302
	67	2	Percheron	8	1250
6	69	1	} Belgian	8	1393
			} Percheron		
	68	2	} Percheron	9	1348
			} Belgian		
7	72	1	} Percheron	March 27, 1909	
			} Shire	4	1309
	73	2	Shire	4	1303
8	74	1	Amer. Trotter	5	1251
	75	2	Amer. Trotter	5	1270
9	76	1	Amer. Trotter	6	1003
	77	2	Amer. Trotter	5	1094
10	79	1	Percheron	March 26, 1910	
				7	1560
	78	2	Percheron	7	1482

TABLE 2.—TEAM NUMBER, HOOF NUMBER, LOT NUMBER, KIND OF HAY FED, INITIAL, AND FINAL WEIGHT AND GAIN OF HORSES

Team	Hoof No.	Lot No.	Kind of hay fed April 2 to Oct. 15, 1908	Weight		Gain or loss lbs.	Kind of hay fed Oct. 15, '08 to March 4, '09	Weight March 4	Gain or loss lb.
				April 2	Oct'r 15				
1	51	1	Timothy	1379	1386	7	Clover	1359	-27
	52	2	Clover	1378	1441	63	Timothy	1341	-100
2	57	1	Timothy	1395	1382	-17	Clover	1515	133
	58	2	Clover	1375	1380	5	Timothy	1555	175
3	60	1	Timothy	1292	1319	27	Clover	1377	58
	59	2	Clover	1292	1259	-33	Timothy	1239	-20
4	64	1	Timothy	1338	1338	00	Clover	1404	66
	65	2	Clover	1420	1374	-46	Timothy	1416	42
5	66	1	Timothy	1302	1318	16	Clover	1363	45
	67	2	Clover	1250	1317	67	Timothy	1289	-28
6	69	1	Timothy	1393	1399	6	Clover	1568	169
	68	2	Clover	1348	1405	57	Timothy	1408	3
Average		2	Timothy	1350	1357	7	Clover	1431	74
			Clover	1344	1363	19	Timothy	1375	12

From Table 1 it will be seen that the horses were fairly uniform in size and age. Table 2 shows the kind of hay fed, the initial and closing weight and gains of the various horses during the first seven periods of the test and also during the last five periods when the hay was reversed. It will be noticed from this table that Lot 1 averaged six pounds heavier per horse at the beginning of the experiment than Lot 2 and made 12 pounds less gain per horse during the first seven periods when fed on timothy hay and 62 pounds more gain during the last five periods when fed on clover hay.

The average daily grain and hay by periods are grouped together in Tables 3 and 4, bringing out clearly the fact that the horses receiving clover hay consumed slightly less grain and hay during the first seven periods and made 12 pounds more gain per horse than those receiving timothy hay. When the hay was reversed, Lot 1 getting the clover, made 62 pounds more total gains per horse during the last five periods than those getting timothy hay, but it will be noticed that they were also getting 1.2 pounds more grain per day than the other lot. This seemingly large gain should be attributed in part to the greater amount of grain fed as well as to the influence of clover. During the first seven periods the horses receiving clover hay did the same amount of work as those receiving timothy hay and on less feed, but when the hay was reversed the gains decreased. The data indicates that there is but little difference in the value of clover and timothy hay when fed in conjunction with corn, oats, oil meal and bran, for feeding farm work horses at hard labor, the difference shown here being slightly in favor of clover. It should be definitely understood, however, that it is not the common practice to feed as great a variety or as near a balanced ration of concentrates as was used in this test. Had corn alone been used as the concentrate quite different results would be anticipated. In other words the roughage part of the ration is not of great importance when the grain fed approximates a well balanced ration.

All the horses in the test remained in good health thruout the experiment excepting No. 60, which was subject to an occasional attack of colic. There was no noticeable difference in the spirit or the ability of the horses to endure hot weather. The horses receiving the clover hay had glossier coats of hair, which is indicative of thrift. Their bowels were looser, but not to such an extent as to be objectionable for doing hard work. The teamsters were frequently asked as to the zest and ability of the horses for endurance, and they reported that no observable difference could be detected, altho most of them had been prejudiced in favor of timothy hay at the beginning. Many people are prejudiced against using clover hay as feed for horses fearing it will produce heaves. Heaves

TABLE 3.—SUMMARY LOT 1, AVERAGE PER HORSE BY PERIODS, AND GENERAL AVERAGE

PERIODS 1 TO 7 INCLUSIVE											
4 week periods ending	Period	Average daily grain, lb.				Average daily timothy lb.	Average wt. at end of period, lb.	Gain or loss lb.	Total labor hours		Average daily labor work days, hours
		Corn	Oats	Oil meal	Bran				Hard	Medium	
April 30.....'08	1	6.77	6.77	.91	.52	15.41	1321	-29	155.	32.9	7 83
May 28. ....'08	2	6.77	6.77	.89	.85	15.71	1307	-14	139.2	26.0	6.7
June 25 '08	3	7.62	7.62	.92	.715	16.07	1283	-24	190.0	20.	8.8
July 23. ....'08	4	7.98	7.98	.92	.57	16.05	1289	6	169.8	47.3	9.0
August 20.....'08	5	7.93	7.93	.92	.57	15.87	1295	6	139.8	68.7	8.7
September 17. '08	6	7.96	7.96	.92	.57	15.91	1334	39	126.3	69.0	8.1
October 15.... '08	7	7.55	7.55	.92	.57	15.93	1357	23	98.	74.6	7.2
Total .....	.....	52.58	52.58	6.40	4.36	110.95	.....	7	1018.1	338.5	...
Average .....	...	7.51	7.51	.91	.62	15.85	.....	1	145.4	48.4	8.1
PERIODS 8 TO 12 INCLUSIVE											
4 week periods ending	Period	Average daily grain, lb.				Average daily clover	Average wt. at end of period, lb.	Gain or loss lb.	Total labor hours		Average daily labor work days, hours
		Corn	Oats	Oil meal	Bran				Hard	Medium	
November 12.. '08	8	7.52	7.52	.....	.57	15.85	1372	15	91.4	101.5	8.0
December 10.. '08	9	7.23	7.49	.....	.57	15.00	1391	19	71.8	91.7	6.8
January 7.....'09	10	5.91	7.39	.....	.57	15.14	1373	-18	96.0	69.6	6.9
February 4.... '09	11	5.51	7.56	.....	.57	15.28	1433	60	39.6	67.5	4 5
March 4..... '09	12	5.43	6.79	.....	.66	15.72	1431	- 2	56.2	60.2	4.9
Total .....	.....	31 60	36.75	.....	2.94	76.99	.....	74	355.0	390.5	...
Average .....	.....	6.32	7.35	.....	.59	15.40	.....	15	71.0	78.1	6.2

TABLE 4—SUMMARY LOT 2, AVERAGE PER HORSE BY PERIODS AND GENERAL AVERAGE

PERIODS 1 TO 7 INCLUSIVE											
4 week periods ending	Period	Average daily grain, lb.				Average daily clover lb.	Average wt. at end of period, lb.	Gain or loss lb.	Total labor, hours		Average daily labor work days, hours
		Corn	Oats	Oil meal	Bran				Hard	Medium	
April 30.....'08	1	6.52	6.52	.82	.49	15.17	1322	-22	155.5	33.3	7.87
May 28.....'08	2	6.64	6.64	.79	.85	15.57	1305	-17.3	139.2	26.	6.7
June 25.....'08	3	7.40	7.40	.79	.715	15.78	1294	-11	190.0	20.	8.8
July 23.....'08	4	7.69	7.69	.79	.57	15.73	1297	3	169.8	47.3	9.0
August 20.....'08	5	7.75	7.75	.79	.57	15.73	1305	8	139.8	68.7	8.7
September 17.....'08	6	7.75	7.75	.79	.57	15.93	1346	41	126.3	66.8	8.0
October 15.....'08	7	6.99	6.99	.79	.57	15.96	1363	17	98.	74.6	7.2
Total		50.74	50.74	5.56	4.33	109.87	.....	19	1018.6	336.7	.....
Average.....		7.25	7.25	.79	.62	15.7	.....	2.7	145.5	48.1	8.1

PERIODS 8 TO 12 INCLUSIVE											
4 week periods ending	Period	Average daily grain, lb.				Average daily timothy	Average wt. at end of period, lb.	Gain or loss lb.	Total labor, hours		Average daily labor work days, hours
		Corn	Oats	Oil meal	Bran				Hard	Medium	
November 2.....'08	8	6.82	6.82	.....	.57	15.85	1351	-12	91.4	101.5	8.0
December 10.....'08	9	6.60	6.89	.....	.61	14.88	1349	-2	71.8	91.5	6.8
January 7.....'09	10	5.41	6.76	.....	.57	15.14	1326	-23	96.	69.6	6.9
February 4.....'09	11	5.17	6.47	.....	.57	15.28	1370	44	38.1	66.6	4.4
March 4.....'09	12	5.10	6.38	.....	.57	15.55	1375	5	57.8	60.9	4.9+
Total		29.10	33.32	.....	2.89	76.70	.....	12	355.1	390.1	.....
Average.....		5.82	6.66	.....	.58	15.34	.....	2.4	71.02	78.02	6.2

is a digestive trouble and more likely to be produced with clover hay than with timothy due principally to the fact that clover is more palatable and consequently a horse is more likely to gorge himself with it when given all he will eat. Dusty hay is more likely to produce heaves than hay of good quality, and the danger from feeding it may be lessened by sprinkling it with lime water.

In arriving at the weight of a horse for a certain feeding period the average of the initial and closing weights were used. The weight of a horse being a variable quantity dependent upon the amount of flesh carried, should be taken in that flesh in which we wish to keep him when at work. In this test the average weight for the 12 periods was used and the grain and hay per 100 pounds live weight computed from this average.

METHODS OF FEEDING

Since the stomach of a horse is a comparatively small organ, the average size being only $3\frac{1}{2}$ gallons while that of a cow, of which there are four compartments, has a capacity of 55 to 60 gallons, it will readily be seen that the horse is poorly adapted to consuming relatively large quantities of coarse feeds. Due to the large amount of crude fiber in hay it requires considerable energy for its digestion and also a much longer time than grains. In feeding the horses used in these tests the practice was adopted of giving the grain in approximately three equal feeds, fed morning, noon and night. The morning feed was given between 5 and 5:30, the noon feed at 12 and the evening feed at 6. As the horses began work at 7 o'clock in the morning, this gave them a full hour and one-half in which to consume and digest their feed before starting to work. One hour was taken for the noon feed. The hay was divided into three feeds; fully half and sometimes a little more was given in the evening, about one-fourth in the morning and a little less than one-fourth at noon. It is believed that much of the digestive troubles of horses are due to the over-feeding on roughages and putting them at work with a distended stomach after they have been allowed to gorge themselves with hay. It is a better plan to limit the hay during the morning and noon feed and give most of it at night when they have a long period of rest and plenty of time for its digestion.

On Saturday nights the regular grain feed was omitted during the first year and a four pound bran mash given in its stead. This was done in order to keep the horses' bowels in good condition, but when an occasional run on grass is given the bran is not necessary. On Sunday the noon feed of grain was omitted and an extra four pounds of hay was given in the morning to teams Nos. 1, 2 and 3. The other three teams received their regular noon feed of grain

as usual on Sundays but no additional hay. During other idle days for whatever cause, after one day had elapsed, the grain was reduced to one-half the usual amount and continued for four days, when it was gradually increased again until the normal amount was given. When the horse was put to work he was put back immediately on his regular grain feed. This was done to prevent azoturia and it seems to be an efficient method.

During the time when a horse receives exercise he is expending energy and his system readily carries off the waste products, but during enforced idleness the system becomes much more sluggish especially when the horse is not accustomed to inactivity. For this reason he should not be fed a full amount of grain for he is not expending the energy he does when at work, or having exercise, and consequently the system is soon likely to become stagnant in not being able to free itself of the waste material. After the elapse of a short time the horse's system seems to readjust itself to its new mode of life, then there is not the danger from giving full feed of grain that there is when he is not accustomed to idleness.

EFFECT OF MINGLING GRAIN WITH CHAFFED HAY

Every observant feeder has noticed that some horses pass a considerable quantity of undigested grain in their feces. Horses with ravenous appetites are more likely to do this than others, due to the fact that they do not chew and masticate their food thoroly before swallowing it and are given insufficient time for its digestion before being put at hard work. This is especially true when at hard work and large feeds of grain are given. In order to find a means of preventing this loss and also of maintaining the health of the horses it was decided to conduct a test where ground grain was mingled with chaffed hay for one horse, while the other in the teams received ground grain and the same kind of hay unchaffed, but the grain and hay were not mingled. As a preliminary study for this test it was observed that from an average of a number of trials conducted with the Experiment Station farm horses it required about thirteen minutes to consume five and one-half pounds of grain (equal quantities of ground oats and cracked corn) when thoroly dampened, twenty-seven minutes to consume the same quantity when fed dry, and about twenty-two minutes to consume the same quantity when fed whole and dry; the difference in time being due to the fact that ground oats and cracked corn fed dry require a longer time for thoroly mixing with saliva in preparation for swallowing.

In carrying out this test of feeding the ground grain mingled with chaffed hay, the entire morning and noon feeds of hay were chaffed and the grain was mingled with it. In most cases from

three to four pounds of chaffed hay were fed in the morning and usually from two to three pounds of chaffed hay were given at noon and two pounds of chaffed hay in the evening, the remainder of the evening hay being fed whole. A like quantity of long hay was fed to the other lot of horses and the grain was ground and fed dry in the usual manner, not mixed with chaffed hay. It was thot that the chaffed hay would not be any more digestible or any more nutritious than the long hay except as it would cause a slower consumption of the grain and a more complete mastication of it. During a part of the time the grain mingled with the chaffed hay was slightly dampened to allay the dust and prevent it from being inhaled as well as to cause the grain and hay to adhere to each other. The dampening of the chaffed hay and grain was discontinued during the hot weather as some of the horses would not always thoroly clean up their feed at time of feeding and it would soon sour when left in the feed box. If the grain is mingled with enough chaffed hay there need be no danger of foundering horses from over-feeding as they will get so much crude fiber that they are not likely to over-eat.

NEW HORSES ADDED

As team No. 2 was later disposed of they were no longer used in these tests, but three new teams were added. Team No. 7, hoof Nos. 72 and 73, were used by the Dairy Department, as were also team No. 9, hoof Nos. 76 and 77, a five and six year old pair of geldings, which showed a predominance of American Trotting Horse blood. Team No. 8, hoof Nos. 74 and 75, were a pair of five year old grade geldings, which showed no particular predominance of any blood unless it was of the American Trotting Horse. They were used by the Grounds Department in caring for the University campus and drives. Nos. 76 and 77 were used on the University milk wagon for the retail delivery of milk thru the city. They worked seven days per week or twenty-eight days a period where the other horses in the experiment worked only twenty-four days per period at the most, often less. This team made the route every day regularly regardless of weather, usually starting at 7 a. m. and returning by 12:30 noon, sometimes a little earlier and sometimes a little later. The wagon to which they were hitched weighed 1280 pounds empty and 2400 pounds loaded; the usual route was thirteen miles long.

With the discontinuing of team No. 2 and the addition of three new teams it became necessary to re-lot the horses in order to balance the lots and make them as nearly uniform as possible. Teams Nos. 1 and 3 were reversed so that Nos. 52 and 59 were designated Lot 1 and Nos. 51 and 60 Lot 2.

TABLE 5.—TEAM NUMBER, HOOF NUMBER, LOT NUMBER, METHOD OF FEEDING GRAIN, AND INITIAL AND FINAL WEIGHT AND GAIN OF HORSES

Team	Hoof No.	Lot No.	Method of feeding grain Mar. 27 to June 19, '09	Weight		Gain or loss lb.	Method of feeding grain June 19 to Aug. 14, '09	Weight Aug. 14, 1909	Gain or loss lb.
				Mar. 27	June 19				
1	52	1	Not mixed with hay.....	1353	1306	-47	Mixed with chaffed clover	1343	37
	51	2	Mixed with hay.....	1356	1297	-59	Not mixed with hay.....	1305	8
3	59	1	Not mixed with hay.....	1241	1165	-76	Mixed with chaffed clover	1162	- 3
	60	2	Mixed with chaffed clover	1391	1319	-72	Not mixed with hay.....	1292	-27
4	64	1	Not mixed with hay.....	1395	1334	-61	Mixed with chaffed clover	1312	-22
	65	2	Mixed with chaffed clover	1405	1381	-24	Not mixed with hay.....	1367	-14
5	66	1	Not mixed with hay.....	1361	1333	-28	Mixed with chaffed clover	1329	- 3
	67	2	Mixed with chaffed clover	1295	1273	-22	Not mixed with hay.....	1261	-12
6	69	1	Not mixed with hay.....	1537	1482	-55	Mixed with chaffed clover	1489	7
	68	2	Mixed with chaffed clover	1429	1399	-30	Not mixed with hay.....	1392	- 7
7	72	1	Not mixed with hay.....	1309	1233	-76	Mixed with chaffed clover	1249	16
	73	2	Mixed with chaffed clover	1303	1251	-52	Not mixed with hay.....	1281	30
8	74	1	Not mixed with hay.....	1251	1221	-30	Mixed with chaffed clover	1231	10
	75	2	Mixed with chaffed hay..	1270	1250	-20	Not mixed with hay.....	1252	^
9	76	1	Not mixed with hay.....	1003	1003	00	Mixed with chaffed clover	993	-10
	77	2	Mixed with chaffed clover	1094	1069	-25	Not mixed with hay.....	1071	?
Average for		1	Not mixed with hay.....	1306	1259	-47	Mixed with chaffed clover	1264	4
		2	Mixed with chaffed clover	1318	1280	-38	Not mixed with hay.....	1278	- 2

Table 5 gives the lotting of the horses, method of feeding grain, weight and gain of the individual horses. The above table shows that the horses receiving the grain mixed with chaffed hay lost slightly less in weight during the first part of the test and gained more during the last part, making a total difference of 15 pounds per horse in favor of the grain mingled with chaffed hay.

Thruout this trial the horses in each team did approximately the same amount of work in all instances and consumed approxi-

mately the same amount of grain. The hay fed to both lots of horses was of the same quality and approximately the same amount, the only difference being the clover which was chaffed and fed with the grain to Lot 2 during the first part of the test and Lot 1 during the last part. The timothy fed in the evening was given whole to both lots of horses. It appeared that No. 77 of team 9 weighed a little too heavy at the beginning of the experiment as his weight record shows a decrease in weight of 32 pounds the first period and after that he maintained his weight quite regularly or increased slightly. No other horse in the experiment showed such a marked falling off at the beginning and maintained his weight so well afterwards, which indicates that this horse's weight was a little above normal at the beginning of the test. Team Nos. 1 and 3 received some bran during the first period. This was given in a bran mash, which was fed on Saturday evenings at which time the regular grain feed was omitted. At the beginning of the third period bran and oil meal were introduced into the ration of all horses and fed with the regular grain feed.

The average weights by periods of this test are given in Tables 6 and 7. A study of these averages will show that Lot 2, the horses receiving the grain mixed with chaffed clover, received .4 pound more grain per day and .3 pound more hay than those not having the grain mixed with hay during the first three periods. Lot 2 lost only 38 pounds during this time while Lot 1 lost 47 pounds.

At the beginning of the fourth period the method of feeding the grain was reversed so that the horse in Lot 1, which previously received the grain unmixed with hay now received it mingled with chaffed clover, while those in Lot 2 received the grain unmixed with hay. A summary of the averages per horse by periods is given in the latter part of Tables 6 and 7. It will be noticed here that the total grain of Lot 1 was .3 pound more per day than that fed Lot 2, while the hay was exactly the same. The results show that the horses receiving the grain mixed with chaffed clover made a total of four pounds of gain per horse while those not having the grain mixed with hay lost two pounds and all the horses did practically an equal amount of labor. These data show that during the entire five periods the horses receiving grain mixed with chaffed clover lost only 35 pounds while those receiving the grain fed in the usual manner lost 49 pounds, making a difference of 14 pounds in favor of the horses receiving the grain mixed with chaffed clover. While the results show a saving due to mixing the grain with chaffed hay, ordinarily it is not sufficient to justify the expense.

Numerous observations were made of the condition of the feces of the various horses in order to note from a physical examination if more grain was excreted in one lot of horses than the other. It is rather difficult to detect ground grain in the feces and as there

TABLE 6.—SUMMARY LOT 1, AVERAGE PER HORSE BY PERIODS AND GENERAL AVERAGE

GRAIN NOT MIXED WITH HAY. PERIODS 1 TO 3 INCLUSIVE												
4 week periods ending	Period	Average daily grain, lb.				Average daily hay, lb.			Gain or loss lb.	Total labor, hours		Average daily labor, work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Whole clover		Hard	Medium	
April 24.	1	7.16	7.16		.14	14.46	7.5	7.66	-15	125.94	45.9	7.05
May 22..	2	7.58	7.58			15.16	7.5	7.89	-29	155.6	44.4	8.27
June 19.	3	6.27	6.27	.92	2.52	15.98	7.23	7.73	-3	145.6	35.6	7.44
Total ...		21.01	21.01	.92	2.66	45.60	22.23	23.28	-47	427.14	125.9	22.76
Average		7.00	7.00	.31	.89	15.20	7.41	7.76	-16	142.38	41.97	7.59

GRAIN MIXED WITH CHAFFED CLOVER. PERIODS 4 TO 5 INCLUSIVE												
4 week periods ending	Period	Average daily grain, lb.				Average daily hay, lb.			Gain or loss lb.	Total labor, hours		Average daily labor, work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Whole clover		Hard	Medium	
July 17.	4	6.11	6.11	.98	2.89	16.09	7.19	7.48*	-7	140.1	37.9	7.29
Aug. 14.	5	6.30	6.30	.99	2.95	16.54	7.25	7.89	1)	154.91	60.7	8.85
Total ...		12.41	12.41	1.97	5.84	32.63	14.44	15.37	3	295.01	98.6	16.14
Average		6.21	6.21	.99	2.92	16.32	7.22	7.69	2	147.51	49.3	8.07

* .4 of a pound of whole clover was fed in addition to the chaffed.

TABLE 7.—SUMMARY LOT 2, AVERAGE PER HORSE BY PERIODS AND GENERAL AVERAGE

GRAIN MIXED WITH CHAFFED CLOVER. PERIODS 1 TO 3 INCLUSIVE													
4 week periods ending	Period	Average daily grain, lb.				Average daily hay, lb.		Average weight end of period, lb.	Gain or loss lb.	Total labor, hours			Average daily labor, work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Chaffed Clover		Hard	Medium		
April 24....	1	7.44	7.44	.....	.17	15.05	6.95	8.51	15.46	123.47	46.5		6.98
May 22.....	2	7.89	7.89	.....	.....	15.78	7.1	8.64	15.64	160.2	43.4		8.39
June 19....	3	6.29	6.29	.92	2.48	15.98	7.21	8.10	15.31	147.3	35.6		7.52
Total.....	...	21.62	21.62	.92	2.65	46.81	21.16	25.25	46.41	430.97	125.5		22.89
Average....	...	7.21	7.21	.31	.88	15.60	7.05	8.42	15.47	143.66	41.83		7.63

GRAIN NOT MIXED WITH HAY. PERIODS 4-5 INCLUSIVE													
4 week periods ending	Period	Average daily grain, lb.				Average daily hay, lb.		Average weight end of period, lb.	Gain or loss lb.	Total labor, hours			Average daily labor, work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Chaffed Clover		Hard	Medium		
July 17.....	4	6.03	6.03	.97	2.88	15.91	7.24	7.46*	15.11	139.	37.9		7.26
August 14..	5	6.18	6.16	.98	2.91	16.23	7.25	7.87	15.12	154.91	53.3		8.55
Total.....	...	12.21	12.19	1.95	5.79	32.14	14.49	15.33	30.23	293.91	91.2		15.81
Average....	...	6.11	6.10	.98	2.90	16.07	7.25	7.67	15.12	146.96	45.6		7.91

* .4 of a pound of chaffed clover was fed in addition to the whole.

was no chemical analysis made there was no means of determining the quantity passed in this manner. However, it appeared from the closest observation that could be made that manure from the horses receiving ground grain mingled with chaffed hay had less grain in evidence than those receiving the grain unmixed with hay. Where the hay and grain were mixed the feces seemed to be in a better condition and the general condition of the horses appeared to be slightly better, as indicated by their coat of hair.

Where horses are fed a heavy grain ration near the limit in quantity, it is believed it is beneficial in preserving the health of the horse to mingle the grain with chaffed hay, altho the results of this test do not show any marked saving. No. 60, which was subject to colic, had fewer attacks when his grain was mixed with chaffed hay than when fed separate. Where the grain is fed with chaffed hay horses are obliged to consume their grain much more slowly and consequently masticate it more thoroly. Corn being a very concentrated and carbonaceous feed sometimes produces deleterious results when fed alone in large quantities. It is believed, however, that its principal danger as a feed for horses is its small amount of crude fiber and low protein content. If a sufficient amount of crude fiber in some form or other were introduced into the ration it would produce a feed which would compare more nearly with oats. For this purpose choice clover or alfalfa hay is preferred to timothy or straw for the reason that the clover and alfalfa furnish more protein than timothy and, too, the ends of chaffed alfalfa and clover are not nearly so sharp on the horse's mouth as chaffed timothy or straw.

CHAFFED CLOVER COMPARED WITH CHAFFED ALFALFA

At the close of the above test on August 14, 1909, the horses in Lot 1 continued to receive their grain mixed with chaffed clover hay, while those in Lot 2 were given their grain mixed with chaffed alfalfa. This test extended over five periods, from August 14 to January 1, 1910, in which chaffed clover was compared with chaffed alfalfa, as a supplement for the grain. The results of this test giving the average daily grain and hay by periods, weight, gain and labor record are set forth in Tables 8 and 9.

Tables 8 and 9 show that the horses receiving alfalfa, received one-fourth pound less grain and one-third pound less hay per horse per day than those receiving the chaffed clover. Those receiving alfalfa did approximately the same amount of labor with less grain and less hay and made a little more gain than those receiving clover. During this experiment it will be noticed that the alfalfa was gradually increased so that the horses became accustomed to it and there was an opportunity to study its effect upon them.

TABLE 8.—SUMMARY LOT 1.—AVERAGE PER HORSE RECEIVING GRAIN MIXED WITH CHAFFED CLOVER, BY PERIODS, AND GENERAL AVERAGE

4 week periods ending	Period	Average daily grain, lb.					Average daily hay, lb.			Average weight end of period	Gain or loss lb.	Total labor, hours		Average daily labor work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Clover				Hard	Med.	
								Whole	Chaffed					
Sept. 11, '09	1	6.08	6.08	.99	2.97	16.12	7.46		7.46	14.92		119.15	91.4	8.6
October 9 ..	2	5.75	5.75	.95	2.79	15.24	7.50		7.39	14.89		163.5	11.	7.22
November 6	3	6.04	6.04	.99	2.94	16.01	6.54	1.78	7.61	15.93		101.	64.41	6.78
December 4	4	6.08	6.08	1.	2.96	16.12	6.26	2.	7.64	15.92		116.97	55.9	7.12
Jan. 1, 1910	5	5.73	5.73	.94	2.79	15.19	6.25	2.	7.56	15.81		104.03	46.22	6.16
Total		29.68	29.68	4.87	14.45	78.68	34.01	5.78	37.66	77.47		604.65	268.93	35.88
Average ...		5.94	5.94	.97	2.89	15.74	6.80	1.16	7.53	15.49		120.93	53.79	7.18

TABLE 9.—SUMMARY LOT 2.—AVERAGE PER HORSE RECEIVING GRAIN MIXED WITH CHAFFED ALFALFA, BY PERIODS, AND TOTAL AVERAGE

							Alfalfa							
		Cracked corn	Ground oats	Oil meal	Bran	Total	Whole	Chaffed						
Sept. 11, '09	1	5.94	5.94	.98	2.9	15.76	7.95	5.96	13.91		1281	115.44	92.56	8.51
October 9..	2	5.7	5.7	.95	2.8	15.15	7.8	6.18	13.98		1298	159.5	10.9	7.05
November 6	3	5.94	5.94	.99	2.93	15.80	6.85	1.78	15.85		1326	94.97	66.78	6.83
December 4	4	6.02	6.02	1.	2.96	16.00	6.63	2.	16.06		1333	116.84	56.4	7.12
Jan. 1, 1910.	5	5.66	5.66	.93	2.77	15.02	6.49	2.	15.83		1347	102.66	47.47	6.15
Total		29.26	29.26	4.85	14.36	77.73	35.72	5.78	34.13		6585	589.41	274.11	35.66
Average		5.85	5.85	.97	2.87	15.54	7.10	1.16	6.83		1317	177.88	54.82	7.13

ALFALFA COMPARED WITH TIMOTHY

In order to further study the effect of alfalfa hay in the ration for work horses it was decided to compare it with timothy hay. The plan of the test was the same as previously, excepting that one horse in each team should receive alfalfa hay and the other horse timothy hay. January 1, Lot 1, the horses receiving the chaffed clover, was changed to a ration where the hay fed was all timothy while Lot 2 was continued on part timothy and part alfalfa. During the first period of the test Lot 1 was given their grain mingled with chaffed timothy and Lot 2 with chaffed alfalfa. Because some of the horses seriously objected to consuming the chaffed timothy, due perhaps to the exceedingly sharp ends of the timothy straw, the chaffed timothy was discontinued at the end of Period 1 and also the chaffed alfalfa. From this time on the grain was not mixed with chaffed hay for any of the horses. From 10½ to 11 pounds of alfalfa and 5 pounds of timothy per horse was fed daily to Lot 2 until the end of the period when they were put on all alfalfa. The summary of the results of this test are set forth in Tables 10 and 11.

It will be noticed that the horses of Lot 2, receiving timothy and alfalfa, received nearly one pound less grain per horse per day and .2 pound more hay than those of Lot 1, which received all timothy hay during the first three periods of the experiment from January 1 to March 26. During this time the horses receiving the alfalfa hay lost seven pounds per horse, while Lot 1 lost nine pounds and all did approximately the same amount of labor. These data would indicate that where alfalfa hay is fed as part of the roughage ration, it will in a measure replace some of the grain.

At the beginning of the next period, March 28, 1910, a new team, No. 10 was introduced into the experiment and at the close of the first period, April 23, team No. 3 was no longer used, as they were later disposed of. From March 26 to May 21 Lot 1 continued to receive timothy as the roughage and Lot 2 were given all alfalfa with the exception of a few feeds of timothy, which were fed to some of the horses through error.

The latter part of Table 11 shows that the horses receiving timothy hay received four pounds more grain per horse per day than those receiving alfalfa. Both lots of horses lost approximately the same amount during the two periods Lot 1, 13 pounds and Lot 2, 12 pounds. The horses receiving the alfalfa hay did an average of nearly one-half hour less work per day than those receiving timothy; this difference being due largely to No. 75, which was unable to work part of the time on account of lameness caused from poor shoeing. It will be noticed that this horse did not maintain his weight any better than the other horses, even tho he did not work all the time.

TABLE 10.—SUMMARY LOT 1, AVERAGE PER HORSE RECEIVING TIMOTHY, BY PERIODS FROM 1 TO 3 INCLUSIVE, AND GENERAL AVERAGE

4 week periods ending	period	Average daily grain, lb.					Average daily hay, lb.		Average weight at end of period, lb.	Gain or loss, lb.	Total labor, hours		Average daily labor or work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy Whole	Timothy Chaffed			Hard	Medium	
Jan. 29.....	1	5.15	5.15	.79	2.20	13.29	7.69	7.49†	1328	5	64.3	56.91	5.48
Feb. 26.....	2	5.01	5.01	.75	2.03	12.80	15.20	.....	1328	.....	91.7	70.22	6.65
Mar. 26....	3	5.55	5.55	.84	2.31	14.25	15.27	.....	1295	—33	174.2	18.1	7.91
Total.....		15.71	15.71	2.38	6.54	40.34	38.16	7.49	3951	—28	330.2	145.23	20.04
Average....		5.23	5.23	.79	2.18	13.45	12.72	2.46	1317	—9	110.1	48.41	6.68
April 23....	4*	6.86	6.86	1.05	2.74	17.51	15.28	.....	1306	—18	182.2	16.4	8.19
May 21....	5	7.26	7.26	.98	2.94	18.44	15.54	.....	1302	—8	181.4	19.9	8.28
Totals.....		14.12	14.12	2.03	5.68	35.95	30.82	.....	2606	—26	363.6	36.3	16.47
Average....		7.06	7.06	1.02	2.84	17.98	15.41	.....	1303	—13	181.8	18.2	8.24

† .57 of a pound of whole clover was fed in addition to the timothy.

* 9 horses during period 4.

TABLE 11.—SUMMARY LOT 2, AVERAGE PER HORSE RECEIVING TIMOTHY AND ALFALFA, BY PERIODS FROM 1 TO 3 INCLUSIVE, AND GENERAL AVERAGE

4 week periods ending	Period	Average daily grain, lb.					Average daily hay, lb.			Average weight at end of period, lb.	Gain or loss, lb.	Total labor, hours			Average daily labor, work days, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Alfalfa Whole	Alfalfa Chopped	Total		Hard	Medium		
Jan. 29..	1	5.18	5.13	.08	2.12	12.56	4.59	3.43	7.19	15.21	12	73.4	60.16		5.48
Feb. 26..	2	5.07	5.07	.....	1.67	11.81	4.9	10.66	.....	15.5	9	91.9	67.28		6.57
Mar. 26..	3	5.70	5.47	.....	2.02	13.19	4.94	10.52	.....	15.46	-41	183.	17.7		8.25
Total ...		15.95	15.72	.08	5.81	37.56	14.43	24.61	7.19	46.23	-20	348.3	145.14		20.50
Average		5.32	5.24	.03	1.94	12.52	4.81	8.20	2.40	15.41	-7	116.1	48.38		6.83
April 23	4*	6.82	6.82	.....	.11	13.75	.34	14.92	.....	15.26	-13	181.	15.7		8.00
May 21..	5	7.14	7.04	.....	.....	14.18	.12	15.31	.....	15.43	-10	170.	17.9		7.72
Total ...		13.96	13.86	.....	.11	27.93	.46	30.23	.....	30.69	-23	351.	33.6		15.72
Average		6.98	6.93	.....	.05	13.96	.23	15.12	.....	15.35	-12	176.	16.8		7.86

* 9 horses used during period 4.

During the time Lot 2 received all alfalfa, the oil meal and bran was discontinued from their ration with the exception of a very small amount which was fed at the beginning of the test.

The results of this test indicate that when a mixed grain ration of corn and oats is fed in conjunction with alfalfa, 20 to 22 per cent less grain is needed to maintain the weight of work horses, than where the grain is fed in conjunction with timothy.

CORN AND ALFALFA COMPARED WITH CORN, OATS, BRAN, OIL MEAL, TIMOTHY AND ALFALFA

At the close of the above test it was decided to continue feeding some of the horses on alfalfa and omit the oats from the grain ration, feeding all corn. One horse in each of three teams was fed in this manner, while the other horse received a mixed grain ration of corn, oats, oil meal and bran and a small amount of alfalfa replaced a part of the timothy. The test extended over two periods from May 21 to July 16, the results of which are set forth in Tables 12 and 13.

It will be noticed that the horses in the various lots did an equal amount of labor. The horses getting the mixed ration with timothy and alfalfa hay received an average daily ration of 18.16 pounds grain while those of Lot 2 receiving corn and alfalfa got only 14.1 pounds grain per day. Both lots of horses received the same amount of hay. This helps to emphasize the conclusion of the previous test, that where alfalfa is fed it will in a measure replace a part of the grain; in this case about 22 percent. At the prices of feed given on page 435, the ration of corn and alfalfa cost 6 cents less per horse per day than the mixed ration, which would ordinarily mean a saving of \$15.00 to \$20.00 per horse annually. Those getting the corn and alfalfa lost an average of eight pounds per horse while the others lost only two pounds per horse. At no time during the test were there noticed any deleterious results from the feeding of alfalfa. The horses ate it with more relish than timothy and it did not prove to be as loosening to the bowels as clover. The alfalfa hay fed was bought for choice quality but some of it contained a few sand-burrs. Part of the hay came from Nebraska and part was purchased from a Kansas City firm. The timothy hay fed from March 26 on was not all of the best quality, some of it being slightly mixed with red top and blue grass.

GROUND GRAIN COMPARED WITH WHOLE GRAIN

At the close of the test in which alfalfa was compared with timothy hay where a mixed grain ration of corn and oats was fed, it was decided to conduct a short test of six weeks in which

TABLE 12.—SUMMARY LOT 1, AVERAGE PER HORSE RECEIVING MIXED GRAIN, TIMOTHY AND ALFALFA BY PERIODS AND GENERAL AVERAGE

4 week periods ending	Period	Average daily grain, lb.				Average daily hay, lb.		Average weight end of period, lb.	Gain or loss lb.	Total labor, hours		Average daily labor, workdays, hours
		Cracked corn	Ground oats	Oil meal	Bran	Total	Timothy	Alfalfa		Hard	Medium	
June 18....	1	7.08	7.08	1.	3.	18.16	11.3	3.68	14.98	177.3	16.2	7.8
July 16.....	2	7.08	7.08	1.	3.	18.16	11.3	3.67	14.97	175.	15.3	7.7
Total		14.16	14.16	2.	6.	36.32	22.6	7.35	29.95	352.3	31.5	15.5
Average.....		7.08	7.08	1.	3.	18.16	11.3	3.68	14.98	176.2	15.8	7.8

TABLE 13.—SUMMARY LOT 2, AVERAGE PER HORSE RECEIVING CORN AND ALFALFA BY PERIODS, AND GENERAL AVERAGE.

	Period	Average daily grain, lb.		Average daily hay, lb.	Average weight end of period, lb.	Gain or loss lb.	Total labor, hours		Average daily labor, workdays, hours
		Cracked corn					Hard	Medium	
June 18....	1	14.		14.98	1275	-19	177.3	16.	7.9
July 16.....	2	14.2		15.	1278	3	173.5	15.3	7.6
Total		28.2		29.98	2553	-16	350.8	31.3	15.5
Average.....		14.1		14.99	1277	- 8	175.4	15.7	7.8

TABLE 14.—SUMMARY LOT 1, AVERAGE PER HORSE RECEIVING WHOLE GRAIN BY PERIODS, AND GENERAL AVERAGE

Dates.	Period	Average daily grain, lb.				Average daily hay, lb.		Average weight end of period, lb.	Gain or loss, lb.	Total labor, hours		Average daily labor work days, hours.
		Whole corn	Whole oats	Oil meal	Bran	Total	Timothy	Alfalfa		Hard	Medium	
June 4—												
June 18..	1	8.22	7.85	.....	2.94	19.01	12.45	3.57	16.02	99.5	6.9	8.87
June 18—												
July 16..	2	7.44	7.54	.....	2.85	17.83	11.69	3.45*	15.55	— 2	20.	8.64
Total		15.66	15.39	.....	5.79	36.84	24.14	7.07	2722	286.9	26.9	17.51
Average....		7.83	7.69	.....	2.89	18.42	12.07	3.54	1361	143.5	13.5	8.76

* .41 clover.

TABLE 15.—SUMMARY LOT 2, AVERAGE PER HORSE RECEIVING GROUND GRAIN BY PERIODS, AND GENERAL AVERAGE

	Period	Average daily grain, lb.				Average daily hay, lb.		Average weight end of period, lb.	Gain or loss, lb.	Total labor, hours		Average daily labor work days, hours.
		Cracked corn	Ground oats	Oil* meal	Bran	Total	Timothy	Alfalfa		Hard	Medium	
June 4—												
June 18..	1	7.11	7.11	.2	2.97	17.39	12.11	3.6	15.71	99.7	6.9	8.89
June 18—												
July 16..	2	6.9	6.9	.19	2.86	16.85	12.36	3.6	15.96	2	20.	8.68
Total		14.01	14.01	.39	5.83	34.24	24.47	7.2	2736	288.1	26.9	17.57
Average....		7.01	7.01	.20	2.92	17.12	12.24	3.6	1368	144.1	13.5	8.79

* Horse No. 74 in Lot 2 was fed a small amount of oil meal by mistake.

ground grain would be compared with whole grain. As a preliminary for this test two weeks were allowed to elapse, in which Teams Nos. 1, 5, 6, 8, and 10 were fed on the same kind of grain and hay. The test began on June 4 and extended to July 16. The horses in Lot 1 received whole grain, consisting of ear corn, whole oats and bran, while those in Lot 2 received cracked corn, ground oats, and bran the same as Lot 1. Both lots of horses received one feed of alfalfa hay of from three to four pounds and two feeds of timothy hay per day. The ear corn fed was figured on a basis of shelled corn. The summary of the results of this test are given in Tables 14 and 15.

It will be noticed from Tables 14 and 15 that the horses getting whole grain received 18.42 pounds per horse per day while those getting the ground grain received 17.12 pounds per horse per day. The hay fed both lots was approximately the same. The horses receiving the whole grain made a total gain of 18 pounds, and those receiving the ground grain made a total gain of 23 pounds. Considering that one ration was approximately as good as the other it will be seen that there was about 9 percent less grain fed where it was ground than where fed whole. Whether or not it will pay to grind grain for horses will depend much upon the convenience and expense of grinding and also upon the amount of work performed by the horse. When the teeth of the horses are good they will do very well on whole grain but when horses are worked near their limit and it is desired to conserve all the possible energy for labor there may be economy in grinding. Ground grain is slightly more digestible than whole grain and it is usually considered by best authorities that a ten percent saving in the grain can be effected by grinding, which is in harmony with the results of this test tho it was too short to be conclusive. It is believed that when the labor is light the saving will not be so great as when the horses are at hard labor.

TABLE 16.—AVERAGE DAILY COST OF RATIONS

Date	Exp.	Lot 1			Lot 2		
		Grain	Hay	Total	Grain	Hay	Total
Apr. 2 to Oct. 15, '08	1	\$.182	\$.095	\$.277	\$.175	\$.079	\$.254
Oct. 15 to Mar. 4, '09	2	.154	.077	.231	.141	.080	.221
Mar. 27 to Aug. 14, '09 ..	3	.173	.083	.256	.173	.083	.256
Aug. 14 to Jan. 1, '10	4	.174	.084	.258	.172	.113	.285
Jan. 1 to May 21, '10	5	.174	.092	.266	.146	.111	.257
May 21 to July 16, '10	6	.201	.096	.297	.126	.112	.238
June 4 to July 16, '10	7	.202	.099	.301	.184	.100	.284

COST OF RATIONS FED

It will be noticed from Table 16, which gives the daily cost of the various rations fed, that in experiment 1 where clover hay was fed Lot 2, there was a saving of about two cents per horse per day over that fed Lot 1, or \$8.40 per horse per year. This difference is due principally to the fact that clover hay is cheaper than timothy. It will also be seen that the horses in Lot 1 ate slightly more feed than those in Lot 2, which in a measure accounts for the difference in the cost.

During experiment 2 Lot 1 receiving clover hay was fed at an expense of one cent more per horse per day than Lot 2 due to consuming more grain and hay.

There was no difference in the cost of the rations in the third experiment as both lots of horses received the same kind of feed and practically the same quantity. It will be remembered that the clover hay fed one lot was chaffed and mingled with grain, but no account has been taken of the labor involved in its preparation.

During the 4th experiment it will be noticed that where alfalfa was fed Lot 2 the ration cost about three cents more per horse per day than Lot 1, which received clover.

Where alfalfa and timothy were compared in experiment 5, the ration of Lot 2 receiving alfalfa was about one cent cheaper than that of Lot 1. The grain part of the ration of lot 2 was about three cents cheaper than that of Lot 1 because of the smaller amount consumed, but alfalfa being more expensive than timothy the economy of the ration fed Lot 2 is only slight.

The greatest economy in making up a ration is brought out in experiment 6. That fed Lot 2, corn and alfalfa, was six cents per day cheaper than that fed Lot 1, which consisted of mixed grain ration of corn, oats, bran and oil meal, timothy and alfalfa hay. While the ration fed Lot 2 was entirely satisfactory the test was too short to determine whether or not such a ration would prove satisfactory for an indefinite length of time. A saving of six cents per day would mean a saving of \$21.90 per horse per year.

The ration fed Lot 2 in experiment 7 was two cents per horse per day cheaper than that fed Lot 1. This difference may be credited to the effect of grinding, that fed Lot 2 being ground grain while that fed Lot 1 was whole grain.

CONCLUSIONS

1. Where a mixed grain ration of corn, oats, oil meal and bran is fed, clover hay is equally as efficient if not a little superior to timothy for horses at hard work.

2. There was no observable difference in the effect of clover and timothy upon the spirit of the horses or their ability to en-

dure hot weather. Those receiving clover had a glossier coat of hair and their bowels were looser, but not too loose to endure hard work.

3. When clover is used as a horse feed, the quality should be good and the quantity fed limited.

4. A slight saving in grain may be made by mingling it with chaffed hay, but the saving in this test did not appear to be enough to justify the expense.

5. There may be a benefit not shown in these tests, in preserving the horse's health, by mingling the grain with chaffed hay. The results of this test are not conclusive on this point.

6. Where the grain was ground and mingled with chaffed clover and with chaffed alfalfa, the latter proved to be a little more efficient in preventing loss in weight of horses at hard work.

7. The mingling of grain with chaffed timothy hay did not prove satisfactory.

8. Where alfalfa hay is fed as the roughage part of a ration for farm horses at hard work, less grain is necessary to prevent them from losing weight than where timothy hay is fed. In this test there was a saving of about 22 percent of grain.

9. Too short to be conclusive these tests indicate that mature horses at hard work can be maintained quite satisfactorily for a short time, at least, on corn fed in conjunction with alfalfa hay, and at a saving in cost.

10. A saving of about ten percent may be made by grinding the grain for farm work horses when at hard labor.

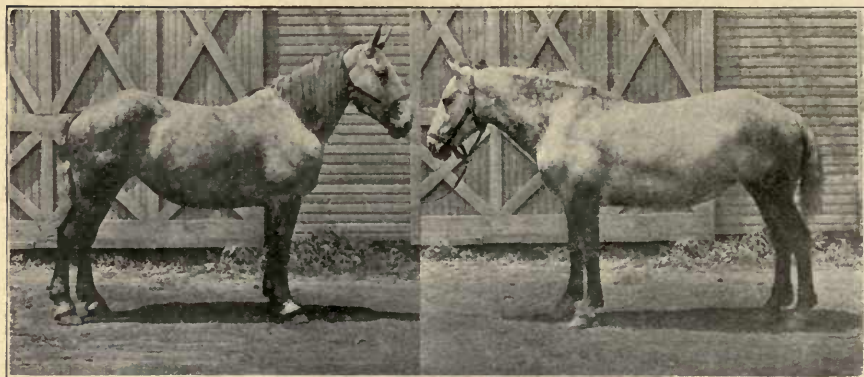
11. It requires twice as long for horses to consume ground grain fed dry, as when the same quantity is fed thoroly dampened.

12. Farm work horses at hard labor should receive from one and one-fifth to one and one-third pounds of grain, and from one to one and one-fourth pounds of hay, per 100 pounds of live weight per day, in order that their weight may be maintained.

13. Satisfactory results have been secured by feeding the grain in three equal feeds, and giving one-half the hay at night, the other half being divided between the morning and noon feeds.

14. The grain fed should be reduced one-half on idle days until four days have elapsed, or until they are again put to work, when it may be again increased if desirable. By following this method attacks of azoturia were prevented.

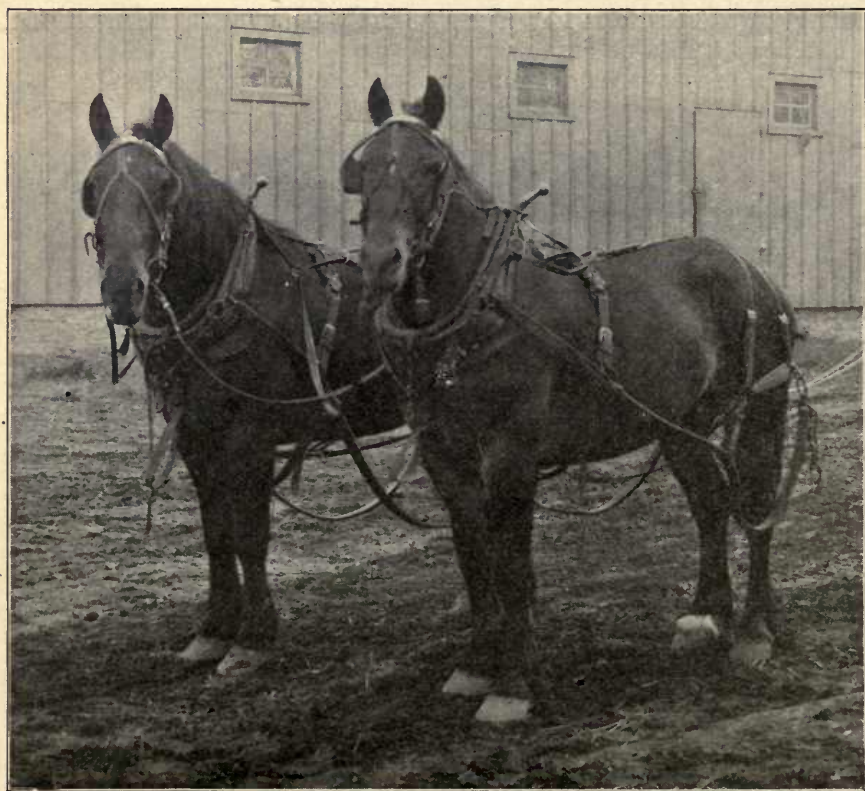
15. The results of the experiment indicate that the general impression is correct that horses may very properly be given a more bulky ration when idle or doing light work than when at heavy work. It is believed that the practice of permitting work horses to gorge themselves with hay is all too common.



No. 52

TEAM No. 1

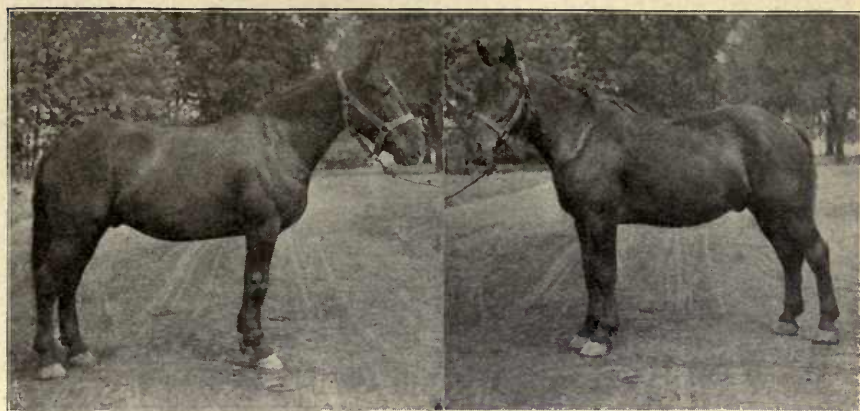
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NEAR HORSE No. 59

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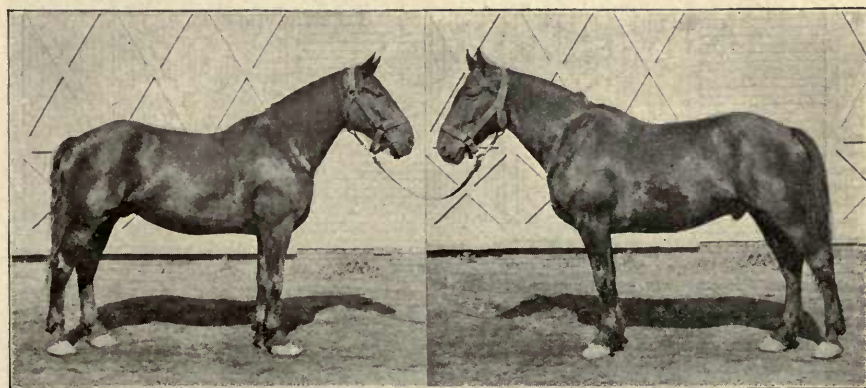
OFF HORSE No. 60



No. 64

TEAM NO. 4

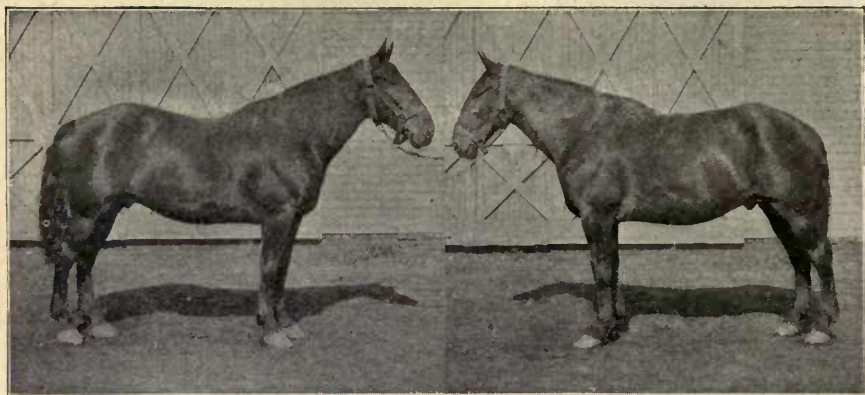
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No. 67

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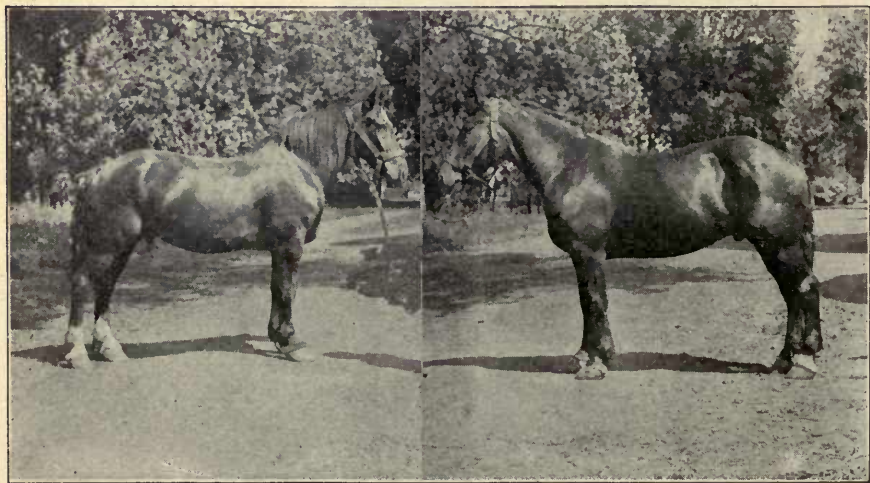
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No. 63

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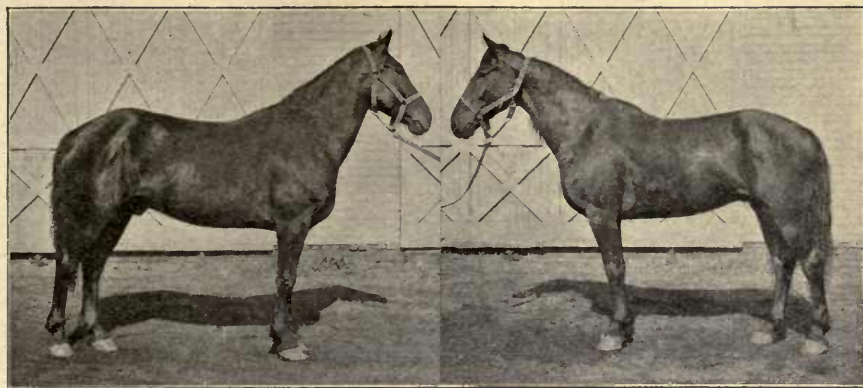
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No. 72

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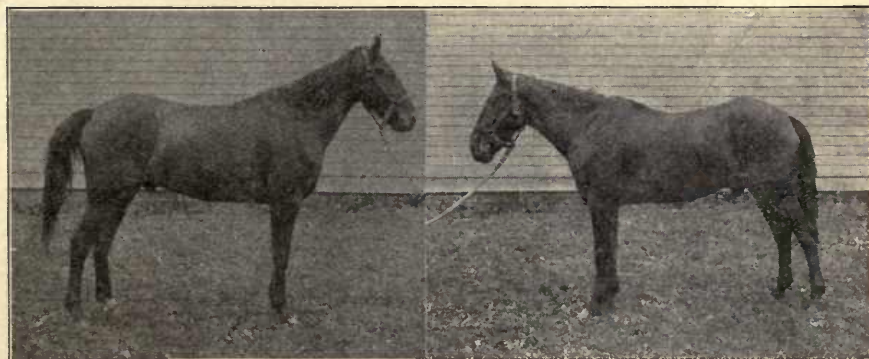
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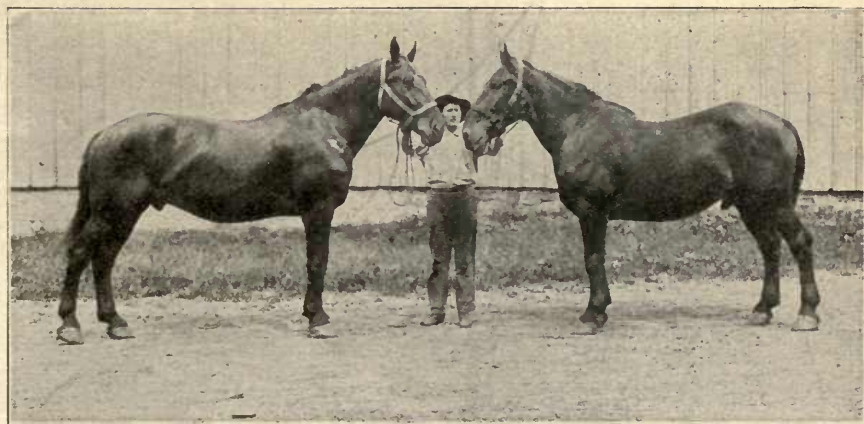
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No. 76

TEAM No. 9

No. 77



No 79

TEAM No. 10

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